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U. S. Nuclear Regulatory Commission
Region II
Sam Nunn Atlanta Federal Center
61 Forsyth Street, SW, Suite 23T85
Atlanta, Georgia 30303-8931

Joseph M. Farley Nuclear Plant – Units 1 and 2
Operability Evaluation of AREVA Cutler-Hammer Breakers

Ladies and Gentlemen:

On October 25, 2007, Southern Nuclear Operating Company (SNC) participated in a call with NRC Region II to discuss current evaluations of AREVA Cutler-Hammer 4160 volt breakers at Farley Nuclear Plant (FNP). SNC identified the current issues with the AREVA Cutler-Hammer breakers and presented the inspection plans and corrective actions to address these current issues.

Unit 1 is currently de-fueled. SNC will inspect and test the AREVA Cutler-Hammer breakers prior to startup from the current refueling outage, to ensure that if called upon, the breakers will perform their intended design function. A discussion of the evaluation is provided in Enclosure 1.

Unit 2 is currently operating at 100 % power. SNC has evaluated the breaker issues as they relate to Unit 2 and determined that the affected breakers remain operable and if called upon, will perform their intended design function. A discussion of the evaluation is provided in Enclosure 2.

The NRC commitments contained in this letter are provided as a table in Enclosure 3. If you have any questions, please advise.

Sincerely,



J. R. Johnson
Vice President – Farley

JRJ/CHM

Enclosures: 1) Operability Evaluation of AREVA Cutler-Hammer Breakers – Unit 1
2) Operability Evaluation of AREVA Cutler-Hammer Breakers – Unit 2
3) List of Regulatory Commitments

cc: Southern Nuclear Operating Company
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**Joseph M. Farley Nuclear Plant – Units 1 and 2
Operability Evaluation of AREVA Cutler-Hammer Breakers**

Enclosure 1

Operability Evaluation of AREVA Cutler-Hammer Breakers – Unit 1

**Joseph M. Farley Nuclear Plant – Units 1 and 2
Operability Evaluation of AREVA Cutler-Hammer Breakers**

Enclosure 1

Operability Evaluation of AREVA Cutler-Hammer Breakers – Unit 1

1. Purpose

SNC has chosen to replace the original Allis-Chalmers 4160 volt breakers with new AREVA Cutler-Hammer (C-H) breakers. During the past few months, SNC has experienced several issues with these new breakers. In addition, quality issues have also been recently identified during installation of these new breakers. SNC will perform evaluations and inspections of the new C-H breakers that will demonstrate these new C-H breakers will meet their design function.

2. Identified Issues

SNC has experienced three (3) additional failures to close on Unit 1 since the NRC Augmented Inspection Team public exit meeting on September 20, 2007. Current issues being addressed with the C-H breakers are:

a. C-Clip Disengagement

A new C-H breaker returned to the vendor for modification failed to close during testing because a C-clip had become dislodged from the Main Link Assembly pin. Without the C-clip to retain them, elements of the Main Link Assembly came apart, preventing closure of the breaker. The problem has been attributed to improper installation of the C-clip during manufacture. This breaker operating mechanism design is widely used across the C-H product line in nuclear and general industry applications, with many thousands in service, but only one other incident of C-clip loss is known.

b. Anti-pump Relay Socket Connection

An installed C-H breaker (Spare Load Center feeder breaker serving no safety related function at the time of failure) failed to close on demand. Investigation revealed that a small plug-in type electrical relay (the "anti-pump" relay, which prevents possible undesirable cycling of the breaker) had fallen out of its socket. With the relay missing, the breaker could not be closed by remote signal. In this application the relay, which normally fits firmly into its socket, is also provided with metal retaining clips which are held in engagement with the relay by means of an encircling nylon tie-wrap. Functional testing (including seismic) has shown that the relay is difficult to dislodge even without the clips or tie wraps.

c. Latch Check Switch

Breaker latch check switches have exhibited some inconsistency regarding repeatable switch function between test stand operation in the maintenance shop and the installed switchgear in the plant. On one

occasion, a C-H breaker failed to close on demand due to a latch check switch actuator arm improper adjustment which caused mechanical interference. In a second incident, a C-H breaker failed to close on demand because the latch check switch actuator arm setting resulted in insufficient travel to make up the switch. If the latch check switch fails to function properly, the breaker would not close on demand because the spring release coil would not energize.

d. Charging Motor Continuing to Run

A C-H breaker was racked to the test position to perform outage surveillance testing. The breaker closed properly but the charging motor continued running. The operation of the breaker contacts is powered by steel springs, and after each closure these springs are charged (i.e. tensioned) by a small electric motor operating through a ratchet mechanism. When the springs are pulled into their charged position, the charging motor is mechanically disengaged from the springs and a switch is actuated by a cam to shut off power to the motor (while another switch is actuated to allow an electrical closure signal to the breaker). The arm which actuates these switches was misadjusted so that its operation was inconsistent. In this case, the switches were not actuated and the charging motor continued running until manually switched off by personnel observing the test. This condition did not affect proper operation of the breaker contacts, which were subsequently demonstrated to open and close upon demand from the control room. The limit switch arm was observed to reset upon operating the breaker which allowed continued operation of the breaker. The charging motor is rated for continuous duty.

e. Closing Stop Roller Cracking

During investigation of the latch check switch, a crack was noted in the closing stop roller of the breaker mechanism. The cracked roller has been removed for analysis and no other instances of this problem are known. Minor surface cracking of the roller will not prevent the breaker from performing its intended function.

f. Ratchet Pawl Spring

During pre-installation checks of a C-H breaker, it was noted that the end of a ratchet pawl spring had slipped out of position. The purpose of this small coil spring is to engage the pawl to provide a ratcheting action as the breaker operating mechanism springs are tensioned by the charging motor. The coil direction of the spring holds the spring in its proper position in normal operation, but the spring could be dislocated during manual charging. Dislocation of the pawl spring could prevent motorized charging of the breaker, a problem which would be apparent during post-installation checkout. No instances of this potential problem are known to have occurred with an installed breaker.

g. Shims Beneath Anti-Rotation Devices

The anti-rotation devices engage a structural angle at the rear of the breaker cubicle to help secure the breaker against the mechanical and electrical forces involved in breaker operation. To accommodate potential variations in the cubicles, factory-installed shims were provided under the

anti-rotation devices. The shims were left in place when some C-H breakers were installed, but subsequent experience has shown that they were not necessary in the FNP cubicles and can make breaker rack-in more difficult.

h. Open-Close Indicator Linkage Interference

Some installed breakers and breakers in pre-installation checkout, were noted to have insufficient clearance in the linkage which operates the mechanical open-close indicator and cycle counter. This could create an impact with an "X-washer" that secures a pin in the linkage and result in the X-washer deformation if it impacts another element as the linkage moves. Proper function of the breaker operating mechanism (aside from indicator and counter function) is not affected by this issue, but it creates the potential for a loose part if the X-washer was broken or pushed off its pin. No such loose parts have been noted.

i. Breaker Stab Alignment

During pre-installation checks several C-H breakers exhibited variance in the breaker stab alignment. The cluster of spring-loaded contacts (or "fingers") on the end of each stab is designed to accommodate some misalignment as the breaker is racked in, but excessive misalignment may cause dislocation of some fingers and a long-term concern with contact degradation.

j. E-Clip Disengagement from the Auxiliary Switch

During pre-installation checks a C-H breaker was operated successfully for several cycles and then failed to close. A linkage arm was found to be disconnected from an auxiliary switch. The spring clip ("E-Clip") designed to retain the linkage arm was missing and not recovered. Without proper operation of the auxiliary switch to detect breaker contact position, the breaker would not perform its intended function.

k. Breaker Closing Circuit Resistance

While performing inspections of C-H breakers, closing circuit continuity was checked with a high-impedance instrument and in a few cases higher than expected circuit resistance was noted. The anomalous resistance readings were traced to circuit elements such as the anti-pump relay contacts, the anti-pump relay socket, and the auxiliary switch contacts.

3. Breakers Selected for Inspection

To meet design basis accidents, the breakers must be able to close on a Safety Injection (SI) signal, reopen on a subsequent Loss of Off-Site Power (LOSP) and then re-close one additional time to accommodate accident recovery actions. Based on these criteria, SNC has selected 24 Unit 1 C-H breakers for inspection. A subset of these breakers is required to support the reload of fuel into the reactor. SNC has determined that seven (7) Unit 1 C-H breakers meet this additional criterion for Unit 1 to enter Mode 6. Additionally, five (5) breakers (to support the second train of Residual Heat Removal) are required to drain the refueling cavity for reactor head installation. The remaining 12 breakers will be inspected prior to Unit 1 entering Mode 4.

4. Inspection Process

SNC has developed the following inspection process to address the identified issues with the C-H breakers installed at FNP. The process will provide additional assurance that the breakers will perform their design function.

- 1) Development of inspection check lists to verify the correct function of breaker sub-components as related to the identified issues.
- 2) Development of detailed inspection instructions including the following quality aspects:
 - a. C-Clip Disengagement: Verify proper seating of C-clip in its groove by visual inspection.
 - b. Anti-pump Relay Socket Connection: Check that relay is fully inserted in socket with retaining clips engaged and tie-wrap tightly around clips and relay (If not completed in recent inspections.)
 - c. Latch Check Switch: Check the latch check switch actuation arm position to ensure no interference and verify proper switch operation.
 - d. Charging Motor Continuing to Run: Check switch actuation arm position relative to cam and verify proper switch operation.
 - e. Closing Stop Roller Cracking: Visually inspect roller for cracking.
 - f. Ratchet Pawl Spring: After conclusion of other breaker inspection activities, verify pawl spring location before re-installing access panel.
 - g. Shims Beneath Anti-Rotation Devices: While breaker is withdrawn for other inspection activities, verify shim removal and anti-rotation device re-installation.
 - h. Open-Close Indicator Linkage Interference: Visually inspect X-washer to ensure it is in proper position and secure.
 - i. Breaker Stab Alignment: Visually inspect primary cluster fingers to ensure good condition.
 - j. E-Clip Disengagement from the Auxiliary Switch: Verify proper seating of E-clip in its groove by visual inspection.
 - k. Breaker Closing Circuit Resistance: With the breaker open and the closing springs fully charged, check the resistance of the closing circuit.
- 3) Briefing of inspectors on the unique aspects of the identified issues and the critical interface of the breaker sub-components.

- 4) Evaluation of inspection results by the breaker oversight team including industry breaker experts.
- 5) The results of these inspections will be incorporated into a root cause evaluation where the extent of condition will be addressed.
- 6) On-site documentation of the inspection process and details of the completed inspections results.

5. Additional Actions Required

Prior to FNP Unit 1 entering Mode 6, the seven (7) breakers will be inspected and verified to function per design.

Prior to FNP Unit 1 draining the reactor cavity with fuel in the core, five (5) breaker inspections, to support the second train of Residual Heat Removal, will be completed and the breakers will be verified to function per design.

Prior to FNP Unit 1 entering Mode 4, the remaining 12 breakers will be inspected and verified to function per design.

SNC will complete the root cause review and determine any additional required actions by December 1, 2007.

6. Conclusion

Problems that have been identified for the new AREVA Cutler-Hammer breakers have been evaluated under the SNC Corrective Action Program. Additional actions identified in Section 5 above will be completed as stated which will provide reasonable assurance that these breakers will function per design.

SNC will continue to monitor the C-H breakers and if any additional problems are identified, they will be addressed in accordance with the SNC Corrective Action Program. This would include appropriate causal analysis and extent of condition.

**Joseph M. Farley Nuclear Plant – Units 1 and 2
Operability Evaluation of AREVA Cutler-Hammer Breakers**

Enclosure 2

Operability Evaluation of AREVA Cutler-Hammer Breakers – Unit 2

**Joseph M. Farley Nuclear Plant – Units 1 and 2
Operability Evaluation of AREVA Cutler-Hammer Breakers**

Enclosure 2

Operability Evaluation of AREVA Cutler-Hammer Breakers – Unit 2

1. Purpose

SNC has chosen to replace the original Allis-Chalmers 4160 volt breakers with new AREVA Cutler-Hammer (C-H) breakers. During the past few months, SNC has experienced several issues with these new breakers. In addition, quality issues have also been recently identified during installation of these new breakers on Unit 1. A broadness review of the identified issues has been performed on Unit 2. SNC has performed inspections of the new C-H breakers that demonstrate these new C-H breakers will continue to meet their design function.

2. Identified Issues

SNC has experienced no C-H breaker demand to close failures on Unit 2. The following broadness issues are applicable to the C-H breakers:

a. C-Clip Disengagement

A new C-H breaker returned to the vendor for modification failed to close during testing because a C-clip had become dislodged from the Main Link Assembly pin. Without the C-clip to retain them, elements of the Main Link Assembly came apart, preventing closure of the breaker. The problem has been attributed to improper installation of the C-clip during manufacture. This breaker operating mechanism design is widely used across the C-H product line in nuclear and general industry applications, with many thousands in service, but only one other incident of C-clip loss is known.

b. Anti-pump Relay Socket Connection

An installed C-H breaker (Spare Load Center feeder breaker serving no safety related function at the time of failure) failed to close on demand. Investigation revealed that a small plug-in type electrical relay (the "anti-pump" relay, which prevents possible undesirable cycling of the breaker) had fallen out of its socket. With the relay missing, the breaker could not be closed by remote signal. In this application the relay, which normally fits firmly into its socket, is also provided with metal retaining clips which are held in engagement with the relay by means of an encircling nylon tie-wrap. Functional testing (including seismic) has shown that the relay is difficult to dislodge even without the clips or tie wraps.

c. Latch Check Switch

Breaker latch check switches have exhibited some inconsistency regarding repeatable switch function between test stand operation in the maintenance shop and the installed switchgear in the plant. On one

occasion, a C-H breaker failed to close on demand due to a latch check switch actuator arm improper adjustment which caused mechanical interference. In a second incident, a C-H breaker failed to close on demand because the latch check switch actuator arm setting resulted in insufficient travel to make up the switch. If the latch check switch fails to function properly, the breaker would not close on demand because the spring release coil would not energize.

d. Charging Motor Continuing to Run

A C-H breaker was racked to the test position to perform outage surveillance testing. The breaker closed properly but the charging motor continued running. The operation of the breaker contacts is powered by steel springs, and after each closure these springs are charged (i.e. tensioned) by a small electric motor operating through a ratchet mechanism. When the springs are pulled into their charged position, the charging motor is mechanically disengaged from the springs and a switch is actuated by a cam to shut off power to the motor (while another switch is actuated to allow an electrical closure signal to the breaker). The arm which actuates these switches was misadjusted so that its operation was inconsistent. In this case, the switches were not actuated and the charging motor continued running until manually switched off by personnel observing the test. This condition did not affect proper operation of the breaker contacts, which were subsequently demonstrated to open and close upon demand from the control room. The limit switch arm was observed to reset upon operating the breaker which allowed continued operation of the breaker. The charging motor is rated for continuous duty.

e. Closing Stop Roller Cracking

During investigation of the latch check switch, a crack was noted in the closing stop roller of the breaker mechanism. The cracked roller has been removed for analysis and no other instances of this problem are known. Minor surface cracking of the roller will not prevent the breaker from performing its intended function.

f. Ratchet Pawl Spring

During pre-installation checks of a C-H breaker, it was noted that the end of a ratchet pawl spring had slipped out of position. The purpose of this small coil spring is to engage the pawl to provide a ratcheting action as the breaker operating mechanism springs are tensioned by the charging motor. The coil direction of the spring holds the spring in its proper position in normal operation, but the spring could be dislocated during manual charging. Dislocation of the pawl spring could prevent motorized charging of the breaker, a problem which would be apparent during post-installation checkout. No instances of this potential problem are known to have occurred with an installed breaker.

g. Shims Beneath Anti-Rotation Devices

The anti-rotation devices engage a structural angle at the rear of the breaker cubicle to help secure the breaker against the mechanical and electrical forces involved in breaker operation. To accommodate potential variations in the cubicles, factory-installed shims were provided under the

anti-rotation devices. The shims were left in place when some C-H breakers were installed, but subsequent experience has shown that they were not necessary in the FNP cubicles and can make breaker rack-in more difficult.

h. Open-Close Indicator Linkage Interference

Some installed breakers and breakers in pre-installation checkout, were noted to have insufficient clearance in the linkage which operates the mechanical open-close indicator and cycle counter. This could create an impact with an "X-washer" that secures a pin in the linkage and result in the X-washer deformation if it impacts another element as the linkage moves. Proper function of the breaker operating mechanism (aside from indicator and counter function) is not affected by this issue, but it creates the potential for a loose part if the X-washer was broken or pushed off its pin. No such loose parts have been noted.

i. Breaker Stab Alignment

During pre-installation checks several C-H breakers exhibited variance in the breaker stab alignment. The cluster of spring-loaded contacts (or "fingers") on the end of each stab is designed to accommodate some misalignment as the breaker is racked in, but excessive misalignment may cause dislocation of some fingers and a long-term concern with contact degradation.

j. E-Clip Disengagement from the Auxiliary Switch

During pre-installation checks a C-H breaker was operated successfully for several cycles and then failed to close. A linkage arm was found to be disconnected from an auxiliary switch. The spring clip ("E-Clip") designed to retain the linkage arm was missing and not recovered. Without proper operation of the auxiliary switch to detect breaker contact position, the breaker would not perform its intended function.

k. Breaker Closing Circuit Resistance

While performing inspections of C-H breakers, closing circuit continuity was checked with a high-impedance instrument and in a few cases higher than expected circuit resistance was noted. The anomalous resistance readings were traced to circuit elements such as the anti-pump relay contacts, the anti-pump relay socket, and the auxiliary switch contacts.

3. Breakers Selected for Inspection

To meet design basis accidents, the breakers must be able to close on a Safety Injection (SI) signal, reopen on a subsequent Loss of Off-Site Power (LOSP) and then re-close one additional time to accommodate accident recovery actions. SNC determined that 13 Unit 2 C-H breakers meet this criterion.

One additional breaker (DF-13) is required to open and re-close on a dual unit LOSP. Inspection of this breaker requires the removal from service of a Bus which is a high risk evolution when performed online. Inspection of DF-13 will be completed as detailed below.

4. Inspection Process

SNC has developed the following inspection process to address the identified issues with the C-H breakers installed at FNP. The process will provide additional assurance that the breakers will perform their design function.

- 1) Development of inspection check lists to verify the correct function of breaker sub-components as related to the identified issues.
- 2) Development of detailed inspection instructions including the following quality aspects:
 - a. C-Clip Disengagement: Verify proper seating of C-clip in its groove by visual inspection.
 - b. Anti-pump Relay Socket Connection: Check that relay is fully inserted in socket with retaining clips engaged and tie-wrap tightly around clips and relay (If not completed in recent inspections.)
 - c. Latch Check Switch: Check the latch check switch actuation arm position to ensure no interference and verify proper switch operation.
 - d. Charging Motor Continuing to Run: Check switch actuation arm position relative to cam and verify proper switch operation.
 - e. Closing Stop Roller Cracking: Visually inspect roller for cracking.
 - f. Ratchet Pawl Spring: After conclusion of other breaker inspection activities, verify pawl spring location before re-installing access panel.
 - g. Shims Beneath Anti-Rotation Devices: While breaker is withdrawn for other inspection activities, verify shim removal and anti-rotation device re-installation.
 - h. Open-Close Indicator Linkage Interference: Visually inspect X-washer to ensure it is in proper position and secure.
 - i. Breaker Stab Alignment: Visually inspect primary cluster fingers to ensure good condition.
 - j. E-Clip Disengagement from the Auxiliary Switch: Verify proper seating of E-clip in its groove by visual inspection.
 - k. Breaker Closing Circuit Resistance: With the breaker open and the closing springs fully charged, check the resistance of the closing circuit.
- 3) Briefing of inspectors on the unique aspects of the identified issues and the critical interface of the breaker sub-components.

- 4) Evaluation of inspection results by the breaker oversight team including industry breaker experts.
- 5) The results of these inspections will be incorporated into a root cause evaluation where the extent of condition will be addressed.
- 6) On-site documentation of the inspection process and details of the completed inspections results.

5. Inspection Results

SNC has satisfied the inspection requirements for the identified breakers per the approved inspection plan with the exception of DF-13. Based on the acceptable results of the inspections performed on the other identified breakers, SNC has high confidence that DF-13 will perform its intended design function. This provides reasonable assurance that each breaker will perform its intended design function.

6. Additional Actions Required

Breaker DF-13 will be inspected by November 1, 2007 to confirm the breaker will perform its design function.

SNC will complete the root cause review and determine any additional required actions by December 1, 2007.

7. Conclusion

Problems that have been identified for the new AREVA Cutler-Hammer breakers have been evaluated under the SNC Corrective Action Program. The required breakers on FNP Unit 2 (with the exception of DF-13) have been inspected and no problems were identified that would prevent the breakers from performing their intended function. DF-13 will be inspected on or before November 1, 2007. SNC will continue to monitor the C-H breakers and if any additional problems are identified, they will be addressed in accordance with SNC Corrective Action Program. This would include appropriate causal analysis and extent of condition.

**Joseph M. Farley Nuclear Plant – Units 1 and 2
Operability Evaluation of AREVA Cutler-Hammer Breakers**

Enclosure 3

List of Regulatory Commitments

**Joseph M. Farley Nuclear Plant – Units 1 and 2
Operability Evaluation of AREVA Cutler-Hammer Breakers**

Enclosure 3

List of Regulatory Commitments

The following table identifies the regulatory commitments in this document. Any other statements in this submittal represent intended or planned actions. They are provided for information purposes and are not considered to be regulatory commitments.

Regulatory Commitments	Due Date
FNP Unit 1 – SNC will inspect 4160 volt AREVA Cutler-Hammer breakers that are required to support the reload of fuel into the reactor. (7 Breakers Total)	Prior to reloading fuel (Mode 6) during Refueling Outage U1 R21 in the fall of 2007
FNP Unit 1 – SNC will inspect 4160 volt AREVA Cutler-Hammer breaker required to support the second train of Residual Heat Removal. (5 Breakers Total)	Prior to draining the reactor cavity with fuel in the core during Refueling Outage U1 R21 in the fall of 2007
FNP Unit 1 – SNC will inspect 4160 volt AREVA Cutler-Hammer breakers that must be able to close on a Safety Injection (SI) signal, reopen on a subsequent Loss of Power (LOSP) and then re-close one additional time to accommodate accident recovery actions. (12 Remaining Breakers)	Prior to entering Mode 4 following Refueling Outage U1 R21 in the fall of 2007
FNP Unit 2 – Breaker DF-13 will be inspected	November 1, 2007
SNC will complete the root cause review and determine any additional required actions.	December 1, 2007